THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

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THE ELECTRIC LIGHT BY INCANDESCENCE.

It has been said that it is possible so to manipulate estimates by means of figures as to make their comparative values to be anything we please. Looking at the numerous calculations which have been made to prove the superior commercial value of the electric over gas lighting, or the reverse, we may well believe that this is the case, as, in spite of all that has been written and spoken on the subject, we seem to be as far as ever from arriving at a just solution of the much-vexed question. At the present time, the question of the arc *versus* the incandescence light, excites considerable differences of opinion amongst practical men. As regards steadiness and simplicity of mechanism, or rather the absence of the latter, the electric light by incandescence bears off the palm; and were it not for the question of cost being unfavourable to the incandescence system, it would leave the arc light very far behind, or rather would throw it out of the field altogether. Several of the so-called incandescence lamps are really partially arc lights—the Werdermann system for example—and in this field there seems special room for progressive improvement. At the last meeting of the Society of Telegraph Engineers it was stated that recent improvements had effected an economy of 100 per cent. in the Werdermann light over the results previously obtained with that system. It was admitted by Dr. Siemens that the candle-power obtained with the Werdermann system per horse-power was very high, that is, supposing the stated values arrived at as the result of experiments were correct. Dr. Siemens has said that the electric light by incandescence can never be as economical as the light by means of the arc; but in this case he alluded to a purely incandescence light as obtained by the heating of a wire or a strip of carbon; considering, however, how erroneous certain predictions as to the possibility of sub-dividing the electric light have turned out, and notably in the case of the Jablochkoff system as at present applied on the Thames Embankment, we may well hesitate to accept the opinion of Dr. Siemens as conclusive, even in spite of the present collapse of Mr. Edison's late experiments.

As regards the general question of electric lighting, there seems to be a general consensus of opinion that the special field for electric lighting is that in which large areas are concerned where it is possible to give uniform illumination by means of a few lamps. At the meeting before referred to, the *space* illuminated was strongly insisted on as being a factor which it is necessary should be taken into consideration when estimating the comparative values of various means of illumination. It has been often noticed that in cases where a small number of electric lights have been employed as a substitute for a larger number of gas jets, that the intermediate space between two electric lights has been in comparative gloom, although the areas in close proximity to the lights has been brilliantly illuminated; where a more numerous number of gas jets were used this disproportion did not exist, so that the comparisons were not just. There can be no question but that in striking a comparison between the electric light and gas there are other factors besides those generally used in making an estimate which must be taken into consideration, and which materially modify the problem, and, until it can be decided what these factors are, it is almost useless attempting to make estimates.

In a paper recently read before the Franklin Institute on the Edison electric light, several points in connection with the latter were mentioned which show how delusive ordinary photometric measurements may be. Speaking of the Edison light, Mr. Outerbridge says:—

"The light from the best lamps is certainly very bright when you *look at it* (it is hinted that the photometric measurements of the lights were made in this rough manner), but the simplest test of its illuminating power is to turn your back upon the source of light, and look at the space brightened by its influence. This trial I found to be an effective check upon any rising enthusiasm in regard to the illuminating value of the light, as compared with a good gas burner. The difference in this respect between the ordinary gas jet and the carbon horseshoe light seems to me to be tersely expressed in the vulgar phrase, that the Edison light is 'too thin,' *i.e.*, while the light from the gas flame proceeds from a large quasi-solid body of luminous particles of carbon, the light from the carbon horseshoe proceeds from *a very thin filament;* it is as though you should cover a gas flame with a little screen which would reveal merely a narrow rim of light; of course the illuminating power of the gas flame would be greatly decreased unless the incandescence of the narrow edge could be increased to a corresponding degree."

Though not attaching any undue importance to the foregoing statement, it will show that something has yet to be learnt on the subject of the science of illumination.

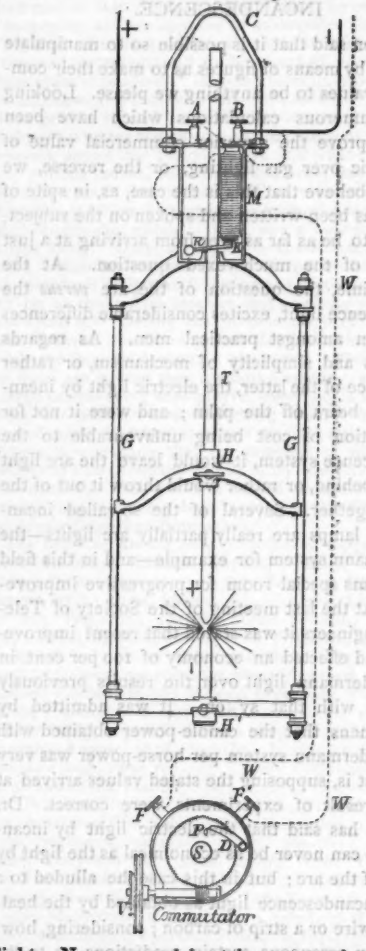
BROCKIE'S ELECTRIC LAMP.

THIS lamp has been designed to overcome many of the imperfections inherent in regulators, and constitutes an important departure from the principles upon which such apparatus have hitherto been constructed. Mr. Brockie having boldly discarded the well-worn principle of regulation by current strength, and with it all the delicate, expensive, and fickle mechanism usual in regulators, has satisfactorily solved the problem of producing a cheap and reliable electric lamp. The new principle and feature of this lamp consists in its periodical re-adjustment, by means of a commutator which cuts out the lamp magnet at stated regular intervals, quite independent of the current strength. This commutator may conveniently be worked by the engine driving the dynamo-machine, and is arranged to cut out the lamp magnet momentarily at short intervals, say about every minute, and it is during this momentary cutting out that the re-adjustment is effected.

Referring to fig. 1, the construction and action of the lamp will be readily understood. The carbons are placed vertically, the upper holder, T, being free to fall by its own weight; a cross head, H, sliding between the guide bars, G, is generally added to the holder, to ensure the carbons being kept directly opposite, and to prevent them overlapping or passing each other. A magnet, M, placed in a branch, W, of the main circuit, controls the upper holder by means of a sudden grip clutch, R. A commutator driven by the engine is placed in this branch circuit, and is timed to interrupt or break the same at regular intervals, say every minute. The action is as follows:—Suppose the carbons are touching—a current is now sent, the branch magnet, M, becomes active and pulls up its armature and the clutch, R, carrying the holder upwards a short distance, thus the arc will be established. The commutator presently cuts out the branch circuit and magnet, the armature therefore falls, together with the holder, the latter continuing its fall until the carbons meet, but as the magnet is instantly re-established the carbons are again separated as at first; after the lapse of about one minute, or other interval which may be arranged, the same operation takes place, and so on until the carbons are consumed, thus the arc is re-adjusted at regular intervals independent of the current strength. It is found in practice that no material increase in the size of the arc takes place during the time the carbons are locked, indeed there is less variation in this respect that in regulators of the Serrin type, where every alteration in the strength of the current has its reflex in the altered size of the arc; however, even this small difference may be prevented by a trifling addition to the lamp, but for all practical purposes no such addition is necessary. It might be thought that when the carbons meet momentarily, a blink or diminution in the light would take place; but the operation of re-adjustment is performed so quickly that no inconvenience is experienced, and the light is practically, absolutely steady. It is found that during the fall of the contact piece, D, from the pin, P, to the disc, S (only one inch), the re-adjustment is effected with certainty.

It will be seen that the carbons in this lamp cannot possibly run together permanently, even although the current should materially decrease, this being a fatal fault in all lamps depending upon current strength for their regulation, and one which gives much trouble to the users of the electric

Fig. 1.

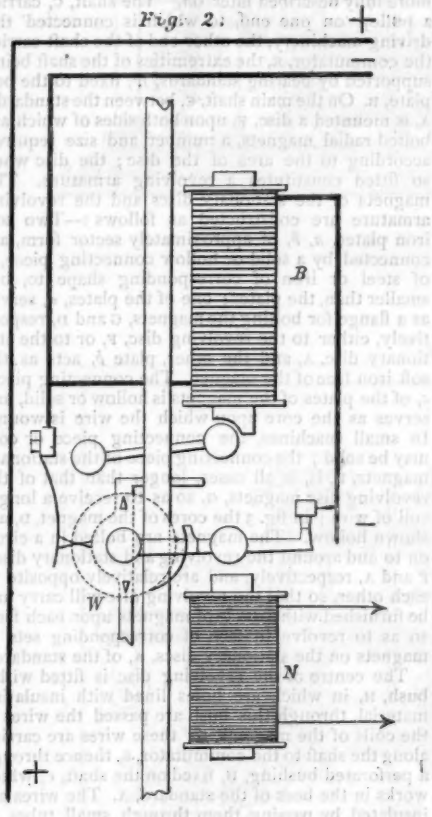


light. No care need be taken as to the speed of the engine, as far as regulation of this lamp is concerned, as the speed may be altered even fifty per cent. without putting it out of gear, a most important advantage in any lamp, and one which no regulator possesses; this feature, together with the simplicity of the lamp, constituting the chief advantages of the system.

Several lamps may be put in circuit and regula-

ted simultaneously, or by putting each lamp magnet in a different branch they may be re-adjusted at different times, so that the main circuit resistance will be more uniform than if all the lamps were re-adjusted at the same time; however, by a modified magnet arrangement, only one shunt and commutator need be used to re-adjust many lamps at different times. Fig. 2 shows this arrangement. The re-adjusting magnet, B, is placed in the main circuit, and a second magnet, N, is used to short-circuit it; this latter is placed in the regulating shunt with the commutator. A small wheel, W, is partially rotated by the pawl, P, at each impulse of the second magnet; this wheel only allows the short-circuiting of the main magnet after a certain number

Fig. 2.



of impulses of the shunt magnet, or at certain points in its revolution, thus, by setting the wheels in the various lamps in circuit at different points, each lamp will be re-adjusted at a different time, although all the magnets are excited simultaneously.

Messrs. Johnson and Phillips, the manufacturers, inform us, that the lamps have been designedly left for hours under the charge of men who were not instructed further than to keep the engine running, practically without a governor, so confident were they that no skilled supervision was necessary; indeed, no lamp we have seen appears to us to be more simple and certain in its action, or less liable to derangement, and will, no doubt, take a leading place amongst the few successful systems of electric lighting. The cost of the lamp and commutator is, we believe, about half that of any good regulator at present in use; the additional expense of a small leading wire to the lamps being inconsiderable, and no objection to the system.

STEWART'S ELECTRIC LAMP.

No. 2.

THE advantages which this lamp possesses may be thus enumerated :—

1. It is automatic in its action.
2. It is capable of burning for a very considerable period.
3. It does not throw any shadows.
4. It is of simple and comparatively inexpensive construction.
5. The intensity of the light may be increased if so desired.

A general view of the lamp is shown by fig. 1, and an underneath view by fig. 2.

A is a disc of wood or other insulating substance having a circular opening in its centre.

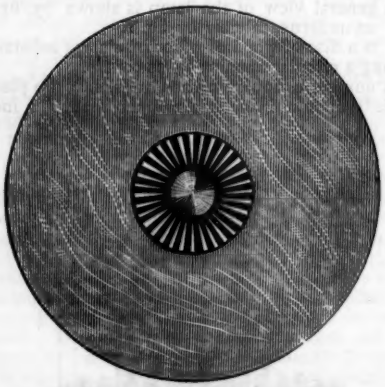
A number of square carbon rods, B B, are placed radially upon A in such a manner that their inner

Fig. 1.

ends impinge one against the other and form a circle. Each carbon slides in a metal case, C, and is forced forward as it is consumed by means of a cord, D, attached to the outer end of the carbon. Each cord passes round a smooth brass ring, F, near the centre of the lamp and runs over a pulley, E, to the iron hoop, G, to which it is attached. The iron hoop, G, is for the purpose of exerting an equal strain upon each of the cords, D D. The carbon rods, B B, are all electrically connected with the positive pole of the dynamo-machine by means of the binding screw, R. H is the negative electrode, and consists of a covered hemispherical cup of copper, through which there is a flow of water from the

cistern, W. The water is conveyed to and from the cistern by means of the flexible tubes, P and Q, and serves to keep the metal electrode cool. Before the electric current passes into the lamp the electrode, H, is resting upon the ends of the carbon rods, B B. When the current enters the lamp it passes through the carbons, B B, into the metal electrode, H, partly along the chain and pulley, L, and electro-magnet, I, and partly along the chain and pulley, M, to the binding screw, S, which is in electrical connection with the negative pole of the dynamo-machine. The magnet, I, thereupon attracts the armature, J, and so lifts up the electrode, H. The electric arc is then formed between one or more of the carbons, B B, and the metal electrode, H. The weights, K K, attached to the chains, L and M, are for the purpose of balancing the electrode, H. The carbon rods, B B, burn evenly away, but the circle formed by their inner ends is not altered in form or size, as the weight of the hoop forces each carbon forward in turn, the amount of carbon consumed in each case being very small. Should the lamp cease to burn, which is very unlikely, it is instantly rekindled by the magnet ceasing to act and consequently allowing the metal electrode to touch the carbons, when the electric circuit is immediately re-established, and the electric arc reformed.

FIG. 2.



The lamp is supported by the cords, T T, from the ceiling of a room, and as the electric arc is formed between the ring of carbons and the metal electrode the lamp does not cast any shadow, as is the case in other lamps. The intensity of the light from this lamp may be increased or decreased by dividing the carbons into groups or sets, each set being insulated from the others and supplied by distinct currents of electricity. In this case switches would have to be provided for connecting or disconnecting the different sets in accordance with the number of currents employed.

It is evident that if a lamp of this description were to be constructed on a very large scale it would burn for a very considerable period of time without requiring any attention.

The lamp is the invention of Mr. Charles Stewart, M.A.

ELMORE'S DYNAMO-ELECTRIC MACHINE.

THE object of this machine is to obtain by improved arrangements and construction of parts a greater extent of the magnetic field of the revolving armature, and so to generate a greater amount of electricity than can be produced with machines of other forms, and also to provide means for the governing the current and cooling the magnets.

The construction of the apparatus is shown by figs. 1, 2, 3, 4, and 5, and is as follows :—A, are end standards, having broad, circular surfaces, and serving as stationary discs, these are bolted to a bed plate, B, the standards having central bosses through which passes the central main driving shaft, C. On the inner surface of these bosses, the stationary magnets, D, are radially arranged in a manner to be more fully described later on. The shaft, C, carries a pulley on one end, to which is connected the driving machinery, the other end of the shaft carries the commutator, E, the extremities of the shaft being supported by bearing standards, B^1, fixed to the bed plate, B. On the main shaft, C, between the standards, A, is mounted a disc, F, upon both sides of which are bolted radial magnets, a number and size required according to the area of the disc; the disc when so fitted constitutes a revolving armature. The magnets of the stationary discs and the revolving armature are constructed as follows :—Two soft iron plates, *a*, *b*, of approximately sector form, are connected by a solid or hollow connecting piece, *c*, of steel or iron of corresponding shape to, but smaller than, the plates; one of the plates, *a*, serves as a flange for bolting the magnets, G and D, respectively, either to the revolving disc, F, or to the stationary disc, A, and the other, plate *b*, acts as the soft iron face of the magnet. The connecting piece, *c*, of the plates of the magnets is hollow or solid, and serves as the core upon which the wire is wound. In small machines, the connecting piece or core may be solid; the connecting piece of the stationary magnets, D, is, in all cases, longer than that of the revolving disc magnets, G, so as to receive a longer coil of wire; in fig. 3 the cores of the magnet, D, are shown hollow. The magnets are bolted in a circle on to and around the revolving and stationary discs, F and A, respectively, and are relatively opposite to each other, so that the revolving disc will carry and be furnished with a circle of magnets upon each face, so as to revolve in face of corresponding sets of magnets on the stationary discs, A, of the standards.

The centre of the revolving disc is fitted with a bush, H, in which are holes lined with insulating material, through this bush are passed the wires of the coils of the magnets, G; these wires are carried along the shaft to the commutator, E, thence through a perforated bushing, H, fixed on the shaft, C, which works in the boss of the standard, A. The wires are insulated by passing them through small tubes of insulating material, as will be understood by reference to figs. 3 and 5.

The wire upon the opposite stationary magnets is wound and connected in such manner as to give opposite polarity to each magnet facing the other, and so forming pairs between which the armature revolves.

For machines of large construction, and where larger currents are to be developed, the number of the armatures, F, and the stationary magnet

Fig. 1.

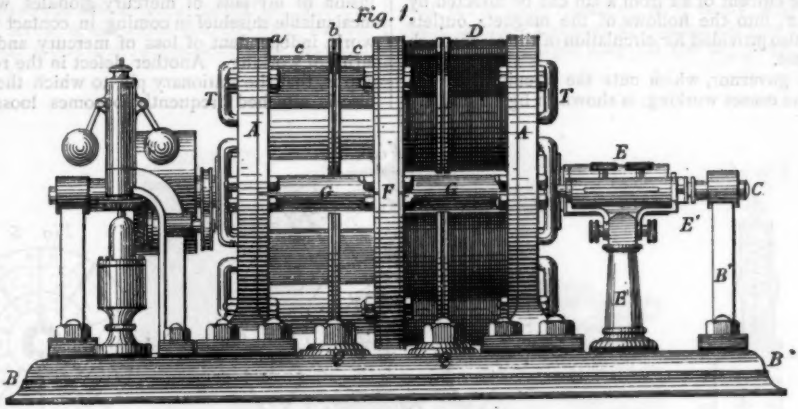
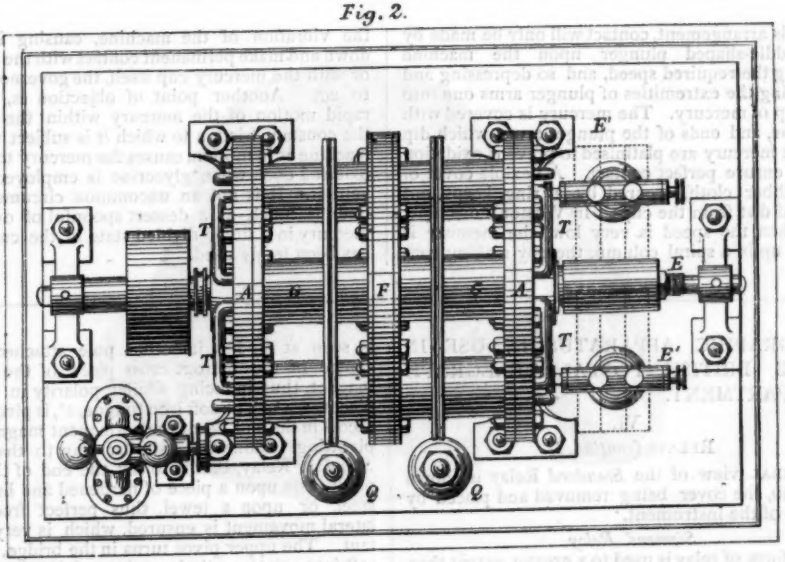


Fig. 2.



standards, A, may be increased; thus, for a machine having two of the revolving armatures upon the shaft, C, there will be provided three stationary magnet standards, A, and so on.

To keep the hollow magnets cool, the stationary disc is perforated at the back of the magnets, and a blast or current of air from a fan can be directed by tubes, T, into the hollows of the magnets, outlets being also provided for circulation of the air through the same.

The governor, which cuts the circuit when the machine ceases working, is shown in figs. 1 and 4.

Fig. 4.

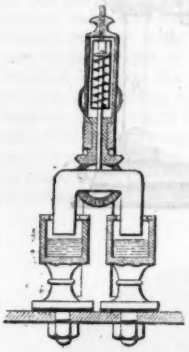


Fig. 3.

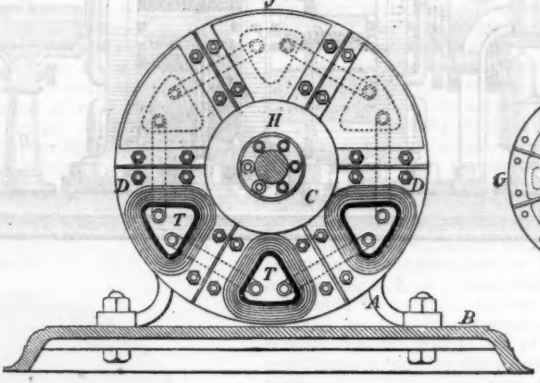
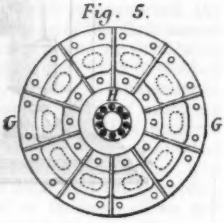


Fig. 5.



In this arrangement, contact will only be made by the saddle-shaped plunger upon the machine attaining the required speed, and so depressing and immersing the extremities of plunger arms one into each cup of mercury. The mercury is covered with glycerine, and ends of the plunger arms which dip into the mercury are platinised to prevent oxidation and to ensure perfect contact. A flexible cover of thin rubber cloth, secured by a ring, keeps out dust and dirt from the cups. In Weston's machine, even when the speed is very low, the mercury is thrown up in a spiral column, thereby making contact with the disc above. Again, when the armature revolves at too high a speed, the mercury is thrown upward with great violence against the contact disc and becomes scattered in more or less minute particles all over the machine and floor, and sometimes bath. In a gilding or plating-room the diffusion of myriads of mercury globules would do incalculable mischief in coming in contact with the work, independent of loss of mercury and irregularity of working. Another defect in the revolving cup is, that the stationary pin to which the contact disc is attached frequently becomes loosened by the vibration of the machine, causing it to slip down and make permanent contact with the mercury, or with the mercury cup itself, the governor ceasing to act. Another point of objection is, that the rapid motion of the mercury within the cup and the constant friction to which it is subject when the machine is in motion, causes the mercury to become oxidised even when glycerine is employed to prevent it. It is not an uncommon circumstance to find as much as a dessert spoonful of oxide and mercury in a finely divided state in the cup after it has been freely used.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

VI.

RELAYS (*continued*).

A GENERAL view of the *Standard* Relay is shown by fig. 30, the cover being removed and placed by the side of the instrument.

Siemens' Relay.

This form of relay is used to a greater extent than any other kind, and its general construction is very generally known. A top view of the instrument is shown by fig. 31. It consists of an ordinary electro-magnet, the poles of which are provided with soft iron shoes, or pole pieces, A, A^1. A permanent curved steel magnet, one end of which is seen at M, has its other pole attached to the centre of the bottom cross piece of the electro-magnet, thus inducing similar polarity in the pole pieces, A, A^1. The soft iron tongue, t^1, is pivotted in a recess in the end, M, of the permanent magnet; this pivotting is done in a similar way to that in the *Standard* Relay, that is to say, the end of the lower pivot rests upon a piece of hardened and burnished steel, or upon a jewel, thus perfect freedom of lateral movement is ensured, which is very important. The upper pivot turns in the bridge, *b*. The soft iron portion, t^1, is prolonged by means of an electrum tongue, *t*, at the end of which is the platinum contact, *c*. In its normal position the end of the tongue rests against the fixed screw piece, s_1, which has a piece of agate let into it, which insulates the tongue from s_1.

A small spiral of wire, *z*, ensures continuity being

preserved between the tongue and the frame of the instrument.

The brass frame piece into which the screws, s_1 and s_2, are secured, is prolonged beneath the plate, P P, the end of the prolongation being hinged; a spring draws the whole piece to the left, and the adjusting screw, S, can move it to the right, so that by a similar action to the adjustment in the *Standard* Relay the screws, s_1 and s_2, can be moved to the left or right as required. The slot in the brass-plate, P P, in which the piece holding s_1 and s_2 slides, is faced round with ebonite, so that s_1 and s_2 are insulated from the frame of the instrument.

Like the *Standard* Relay, the Siemens' instrument is wound differentially to a resistance of 200 ohms each coil, or 400 ohms in all. To obtain good signals on the Relay a current through either of the coils equal to 2½ milliwebers is required.

Although the Siemens' Relay, as ordinarily constructed, is a good form of instrument, and works well, yet in some respects it is of faulty design and construction. The moving armature is very heavy, and its whole weight drags on the top pivot of its axle, thus causing considerable friction. The flat, thin form given to the whole armature causes it to be springy. Rigidity in the tongue of a relay, although it may be difficult to understand why it is the case, makes a very considerable difference in its working qualities, indeed for some purposes a springy armature is fatal to good working. Heavi-

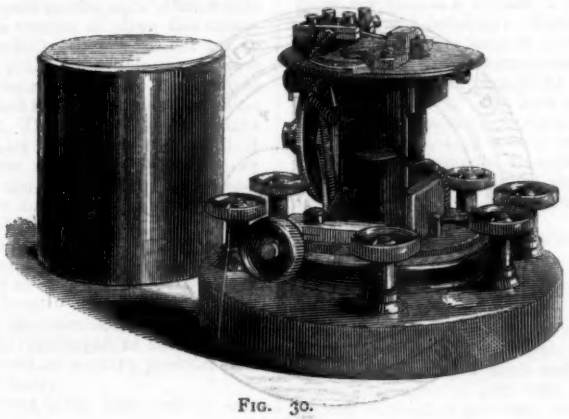


FIG. 30.

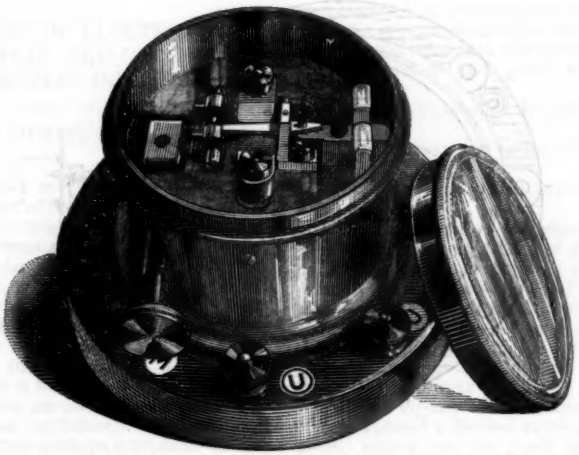


FIG. 33.

ness, from the inertia of the mass, is also fatal to rapid working, and a badly-balanced armature is also prejudicial.

To get rid of these bad qualities a large number of the Siemens' Relays are now being converted, and with excellent effect.

The Improved Siemens' Relay.

Figs. 32 and 33 show in general plan and perspective the altered form of Siemens' Relay. The smaller than the old form of armature seen in fig. 31.

The old bridge piece, *b* (fig. 31), is removed, and another bridge planted more forward in the position shown. A soft iron piece, *i*, is screwed down to the brass plate, P P, one end fitting between the slot in the magnet, M, which contained the axis of the old armature; the other end of *i* is in close proximity to the back of the soft iron tongue, *t'*, so as to polarise the latter. The old contact screws,

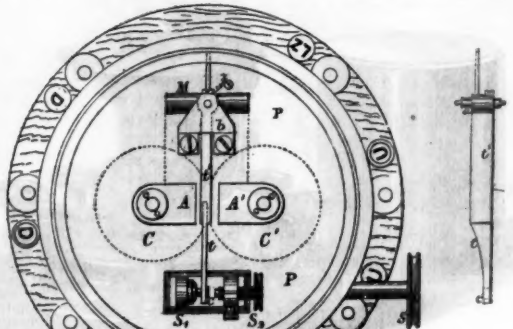


Fig. 31.

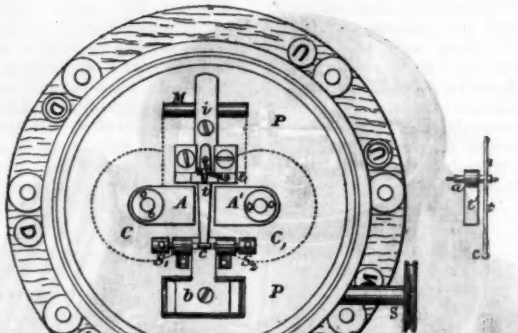


Fig. 32.

alterations are not great, and, moreover, are very easily effected at a small expense. Referring to the right hand figure of fig. 32, it will be seen that the armature consists of a short soft iron tongue, *t'*, similar to those in the *Standard* Relay; this tongue is fixed on a short steel axle, with pivots similar to those in the ordinary Siemens' Relay; a thin tongue, *t*, with a contact platinum piece, *c*, is also fixed to the axle. The whole, in fact, forms a very light and rigid armature, being considerably s_1, s_2, are removed, and the piece into which they screw is cut down, and a new piece, *b*, provided with screws, s_1, s_2 (the former of which is tipped with ivory) is screwed to the same, so that the adjusting screw, s, can regulate s_1 and s_2 in the ordinary way. By having s_1 and s_2 brought near the centre of the instrument, the tongue, *t*, can be made short as shown. Experiments showed that a long tongue considerably diminished the sensitiveness of the arrangement. The reason of this is, tha

there is a tendency for the contact points to stick together, either from natural cohesion or from the local current slightly fusing the points together; with a long tongue the leverage exerted at the contact points by the short soft iron tongue, *t*, is considerably less than is the case with a short tongue. There is, however, a limit to the brevity of the tongue, *t*, for if it is made too short the movement of the soft iron tongue, *t'*, necessary to fairly make and break contact, becomes comparatively great, and thus the latter is thrown at each movement closer to one or other of the soft iron pole pieces, A_1 A^1, than would be the case with a less amount of play; this causes sticking, from the inability of a weak current to overcome the natural pull of the pole piece upon the tongue when the latter is near it. The relative proportions adapted, and shown in the fig., are found to give the best effect. The result of the alterations is such that the Relay will work well with 1 milliweber of current instead of requiring 2½ milliwebers, as was the case before conversion. The advantages of this increase in the sensitiveness of the instrument is obvious.

In the altered instrument the pole pieces, A_1 A^1, do not require adjustment should the working current be very strong or very weak. This was not the case with the old form.

The connections to the terminals in the altered instrument have been rearranged, as shown, so as to make them correspond in relative position with those in the *Standard* Relay.

The general appearance of the Relay will be seen from fig. 33.

ON THE INFLUENCE OF ELECTRIC LIGHT UPON VEGETATION, AND ON CERTAIN PHYSICAL PRINCIPLES INVOLVED.*

By C. WILLIAM SIEMENS, D.C.L., F.R.S.

ABOUT two years ago I mentioned to Sir Joseph Hooker, then President of the Royal Society, that I thought the electric arc might be found sufficiently powerful to promote vegetation, and that I should be willing to undertake some experiments on the subject if he could give me any hope of confirmative results. Sir Joseph Hooker gave me sufficient encouragement to induce me to follow up the subject, and I have since that time gradually matured a plan for conducting the experiment. Operations were commenced only at the beginning of the year, and although the results are necessarily incomplete, they are nevertheless sufficiently positive and remarkable to make them perhaps acceptable to the Royal Society as a preliminary communication on the subject. I was induced to look for interesting results in these experiments on account of the great abundance of blue and actinic rays in the electric arc, upon which its value in photography depends. In experimenting with powerful electric lamps for illuminating purposes, I have been struck moreover by the action produced upon the skin, which is blistered, without the sensation of excessive heat at the time, an effect analogous to that produced by solar rays in a clear atmosphere.

Effect of Radiant Energy on Plants.

The apparatus which has been put up at Sherwood consists—1. Of a vertical Siemens dynamo-machine, weighing 50 kilos., with a wire resistance of 0·717 unit on the electro-magnets. This machine makes 1,000 revolutions a minute, it takes 2 horse-power to drive it, and develops a current of 25 to 27 webers of an electromotive force of 70 volts. 2. A regulator or lamp, constructed for continuous currents, with two carbon electrodes of 12 millims. and 10 millims. diameter respectively. The light produced is equal to 1,400 candles measured photometrically. 3. A motor, which at present is a 3 horse-power Otto gas-engine, but which it is intended to supersede by a turbine to be worked by a natural supply of water, at a distance of about half a mile from the house.

Experiments on Effect of Electric Light on Plants.

My object in making these experiments was to ascertain whether electric light exercised any decided effect upon the growth of plants. For this purpose I placed the regulator in a lamp with a metallic reflector, in the open air, about 2 metres above the glass of a sunk melon house. A considerable number of pots were provided, sown and planted with quick-growing seeds and plants, such as mustard, carrots, swedes, beans, cucumbers, and melons. The plants could then be brought at suitable intervals under the influence of daylight and electric light, without moving them, both falling upon them approximately at the same angle. The pots were divided into four groups.

1. One pot of each group was kept entirely in the dark.

2. One was exposed to the influence of the electric light only.

3. One was exposed to the influence of daylight only.

4. One was exposed successively to both day and electric light.

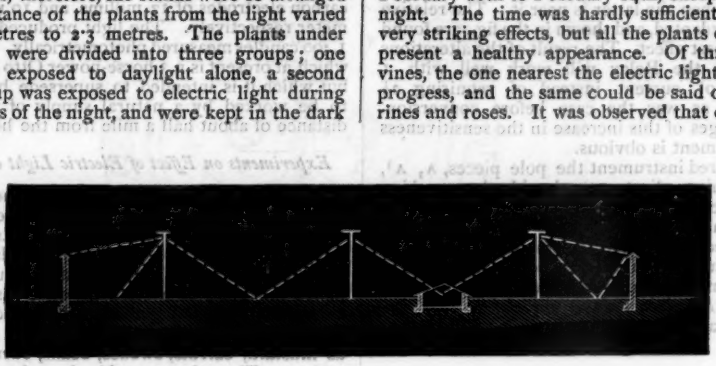
The electric light was supplied for six hours, from 5 to 11 each evening, all the plants being left in darkness during the remainder of the night.

In all cases the differences of effect were unmistakable. The plants kept in the dark were pale yellow, thin in the stalk, and soon died. Those exposed to electric light only showed a light-green leaf, and had sufficient vigour to survive. Those exposed to daylight only were of a darker green and greater vigour. Those exposed to both sources of light showed a decided superiority in vigour over all the others, and the green of the leaf was of a dark rich hue.

The preliminary trials proved that electric light can be utilised in aid of solar light by placing it over greenhouses, but the loss of effect in such cases must be considerable. I, therefore, directed my observations, in the next place, to the effect of electric light upon plants, when both were placed in the same apartment. A section of the melon house, already referred to (7′ 3″ × 3′ 3″, 2·21 m. × 0·19 m.), was completely darkened by being covered in with thick

* Proceedings of the Royal Society.

matting, and was whitewashed inside. The electric light was placed over the entrance door, and shelves were put down, in a horse-shoe form, to receive the pots containing the plants to be exposed to the action of electric light, the plants being placed at distances from the lamp varying from 0·5 metre to 2 metres. Upon the first occasion of trying the naked electric light in this manner, some of the plants, and especially some melon and cucumber plants, from 20 centims. to 40 centims. in height, which were within a metre distance from the lamp, commenced to suffer; those leaves which were directly opposite the light turning up at the edges and presenting a scorched appearance. On subsequent nights, therefore, the stands were so arranged that the distance of the plants from the light varied from 1·5 metres to 2·3 metres. The plants under experiment were divided into three groups; one group was exposed to daylight alone, a second similar group was exposed to electric light during eleven hours of the night, and were kept in the dark



chamber during the day time, and the third similar group was exposed to eleven hours' day and eleven hours' electric light. These experiments were continued during four days and nights consecutively, and the results observed are of a very striking and decisive character, as regards the behaviour of such quick-growing plants as mustard, carrots, &c.

A pot of tulip buds was placed in this electric stove and the flowers were observed to open completely after two hours' exposure.

One object I had in view in this experiment, was to observe whether the carbonic acid and nitrogenous compounds produced within the electric arc exercised any deleterious action upon the plants. All continuous access of air into the stove was closed, and in order to prevent excessive accumulation of heat, the stove pipes were thickly covered with matting and wet leaves. But although the access of stove heat was thus virtually stopped, the temperature of the house was maintained throughout the night at 72° F., proving that the electric lamp furnished not only a supply of effective light, but of stove heat also. No hurtful effect was moreover observed on the plants from the want of ventilation.

The next step in the course of these experiments was to remove the electric lamp into a palm house, constructed of framed glass, which was 28 ft. 3 in. long, 14 ft. 6 in. wide, and averaging 14 ft. 6 in. (8·62 m. × 14·42 m. × 4·42) in height. In the centre of this house a banana palm, and a few other small palm trees are planted, the sides of the house all round being occupied with a considerable variety of flowering plants. The electric light was fixed as high as practicable at the south corner of the house, in order that its rays might fall upon the plants from a direction and at an angle coincident with those of the sun during the middle of the day. A metal reflector was placed behind the lamp, in order to utilise the electric rays as much as possible. Along the eastern side of the house are some young vines, having their roots in a bed outside. Three pots of nectarine plants, just beginning to bud, were placed on the floor at various distances from the electric light, and also some rose plants, geraniums, orchids, &c. The temperature of the house was maintained at 65° F., and the electric lamp was kept alight from 5 p.m. to 6 a.m., for one week, from February 18th to February 24th, excepting Sunday night. The time was hardly sufficient to produce very striking effects, but all the plants continued to present a healthy appearance. Of three Alicante vines, the one nearest the electric light made most progress, and the same could be said of the nectarines and roses. It was observed that other plants, such as geraniums, continued to exhibit a vigorous appearance, notwithstanding the heat of the place. The electric light appeared to impart the vitality necessary to prevent a collapse of the organism through excessive temperature. This experiment is of importance in showing that the electric light, if put into conservatories or greenhouses, does not injure the plants, but rather improves their appearance and growth. The leaves assume a darker and more vigorous appearance, and it seems that the colouring of the flowers becomes more vivid, but a further period of time is necessary to establish this observation absolutely. Although the amount of heat given off from the electric arc is not great compared with a gas flame (giving off its products of combustion), yet the rays of intense heat of the arc counteract that loss of heat by radiation from the leaves into space, which during a clear night causes hoar frost. For this reason I expect that electric light may be usefully employed in front of fruit walls, in orchards, and in kitchen gardens, to save the fruit-bud at the time of setting; and in this application electric light will probably be found a useful agent, not only to promote rapid growth, but to insure a better yield of fruit.

Estimated Cost of Electro-Horticulture.

The experiments before given show that the most effective height at which to place the naked electric light of 1,400 candle-power is about 2 metres. By providing a metallic reflector, and thus throwing the major portion of the upward rays down upon the surface to be illuminated that height

may be taken at 3 metres. If the electric arc employed was equal to 6,000 candles, the height would be $\frac{\sqrt{6,000}}{\sqrt{1,400}} \times 3 = 6{\cdot}2$ metres, at which height an electric light should be fixed under the protection of a tin plate or other reflector. In operating upon an extended surface several lamps should be placed at such distances apart as to make the effect over it tolerably uniform. The effect of radiation would be equally distributed over the ground if the radiating centres were placed at distances apart equal to double their height above the ground; for under these circumstances a square foot of surface midway between them would receive from each centre one-half the number of rays falling upon such a surface immediately below a centre. A plant at the intermediate point would, however, have the advantage of presenting a larger leaf surface to the two sources of light; and in order to compensate for this advantage, the light centres may be placed considerably further apart, say at distances equal to three times their elevation, or 18 metres. Nine lights so placed would cover an area 54 metres square, or just about ¾ acre. If this space was enclosed with a high fruit-wall (as shown with the lamp centres marked in the accompanying sketch), this will also get the full benefit of electric radiation and would serve at the same time to protect the plants from winds. Protection against injury from this latter cause might be further carried out with advantage by the following plan adopted (with excellent results I believe) by Sir William Armstrong, that of subdividing the area under forced cultivation by vertical partitions of glass.

The engine-power necessary to maintain this radiant action would be $9 \times 4 = 36$ horse-power, involving the consumption of $36 \times 2\frac{1}{2} = 90$ lbs. of fuel per hour, or say, for a night of 12 hours (with an allowance of 40 lbs. for getting up steam) 10 cwt., which, at sixteen shillings per ton, would cost eight shillings. This expenditure would not include, however, the cost of carbons and of an attendant, which would probably amount to another eight shillings, making a total of sixteen shillings. If, however, an engine can be found doing other descriptions of work during the day time, the cost of steam-power and attendance for the night-work only would be considerably reduced. In the calculation just given, I have assumed the employment of fuel for the production of mechanical energy, whereas the question will assume a totally different aspect if natural sources of power, such as waterfalls, can be made available within the reasonable distance of half a mile. The expenditure for energy will, in that case, be almost entirely saved, and that of attendance be greatly diminished, and under such circumstances it seems probable that electro-horticulture may be carried out with considerable advantage.

The experiments furnish proof that the management of the electrical apparatus presents no particular difficulty, as the gas-engine, dynamo-machine, and regulator have been under the sole management of my head gardener, Mr. D. Buchanan, and his son an assistant gardener. The regulator requires no attention beyond the replacement of carbons every four or five hours, which period may easily be increased to twelve hours, by a slight modification of the lamp.

Notes.

A system of pneumatic clocks has recently been inaugurated in Paris, the motive power is obtained from a steam-engine which compresses air and distributes it every minute through a pipe with which the clocks are in communication, thus at every minute the hands of all the clocks in connection with the tube are moved forward a corresponding distance. The employment of a steam-engine in the place of a small battery, and the employment of a tube in the place of a small wire, does not seem to be a very progressive improvement.

Although as regards clocks, pneumatic power in Paris seems to be in the ascendant, yet *La Lumière Electrique* announces that it is in contemplation in Paris to transmit message forms bodily by electricity instead of by pneumatic power as at present. To this end small engines driven by electricity are employed, the whole forming a miniature railway. The system has been tried, and it is stated that the small engines will run with a load of 14 lbs. at the rate of 15 miles an hour.

Since the paper on "Influence of Electric Light on Vegetation" was read, Dr. Siemens has written a letter to the editor of the *Gardener's Chronicle*, in which he says, that "The strawberries exposed to the electric light have made extraordinary progress, and I shall exhibit before the Royal Society to-morrow night two pots that were exactly alike a fortnight ago, the one which was exposed to the electric light having now ripe fruit, while the other, which was exposed to solar light only, but kept at the same temperature, has, as yet, only unripe green fruit. At the Royal Society to-morrow you will have an opportunity of tasting the fruit, to ascertain whether the electric light produces aroma or not. It is also interesting to observe some melon plants, which did remarkably well under the night influence of the electric light, but which have produced fewer leaves since the light has been shifted to another point for the strawberries. Regarding the question of cost, I find that the power cost me 67 cubic feet of gas per hour, say 4s. per hour, or, including attendance, 6s. per hour for a light of 1,400 candle-power. Greater powers than this would be relatively cheaper."

Mr. W. Chew, of Blackpool, recently read a paper before the Manchester District Institution of Gas Engineers, entitled, "Three Months' Experience of Electric Lighting at Blackpool." In it he gives the capital expenditure for electric light at Blackpool, Westgate, and Thames Embankment, respectively, as:

Blackpool (six lights=36,000 candles available)	£2,800
Westgate (six lights=1,182 candles available	1,100
Thames Embankment (twenty lights=4,000 candles available	2,000

Also, he compares the working expenses now at Blackpool with the others, for one night of 5½ hours, thus:

Blackpool, 36,000 candles	£3 6 10
Westgate, 1,182	1 16 10
Thames Embankment, 4,000	3 8 8

Dr. Siemens on the Applications of the Dynamo-Electric Machine.—The Friday evening lecture on March 12th was delivered by Dr. C. W. Siemens, the subject being "The Applications of the Dynamo-Electric Machine." Faraday's discovery in 1831 of magneto-electric induction was first referred

to, the identical apparatus from which the first magneto-electric spark was obtained being exhibited and experimented on. The discovery of Faraday was the result of several years of laborious thought, and was not a mere accidental discovery. The apparatus with which Faraday experimented, although it demonstrated the principle of magneto-electric induction, only produced feeble effects, and it was not until the invention of the armature of Dr. Werner Siemens, which bears the latter gentleman's name, that powerful magnetic currents could be produced; the invention of the Siemens armature was made in 1854. This form of armature was utilised by Professor Holmes in his powerful magneto-machine, and subsequently by Wilde of Manchester. In 1867 the accumulation or reaction principle was announced to the Royal Society simultaneously by the author and Sir Charles Wheatstone. This principle is the foundation of the dynamo-electric machine. Dr. Siemens stated that so far as he himself was concerned he considered that the merit of the discovery belonged to his brother, Dr. Werner Siemens of Berlin. The power of the dynamo-machine was illustrated by its power to fuse a wire and to turn a fan, the machine being driven by hand. With a more powerful machine a circular saw was turned, thus illustrating the principle of the transmission of power. The electrical railway was then alluded to. The electric light, Dr. Siemens stated, could be furnished in the simplest manner by the incandescent system, but this could never excel the arc in economy. The great heating power of the arc was such that it had been applied to the fusion of metals in a crucible. In this arrangement one electrode was placed through the bottom of the crucible and the other electrode was attached to a solenoid regulator, which kept the length of the arc between the two carbons regular. Pieces of steel placed in the crucible were fused in about twenty minutes, which was much quicker than would be the case in an ordinary blast furnace. The application of the electric light to horticulture was also alluded to and explained.

THE magistrates of the city of Berlin have appointed a special commission of engineers and architects to examine into and report upon the scheme for the construction of an electric railway across a portion of the capital submitted by Messrs. Siemens and Halske. The line would start from the Belle Alliance Place, and run through Friedrich and Chaussée Streets on to the Wedding Place. There will be two lines of rails, one for the up and the other for the down journey. The viaduct will be carried on iron pillars 14ft. 9in. high, and nearly 33ft. apart. These pillars will be placed along the edge of the footpath, so as to cause the least possible interference with the ordinary traffic. The carriages will be narrow and short, containing ten sitting-places and four standing-places. The electro-dynamic machine which will propel the carriages will be placed under the floor of the carriage between the wheels, and a steam-engine of 60-horse power, which will be employed in the production of the electricity, will be placed at the terminus. The stoppages will be very few, and the rate of speed will be, it is expected, about twenty miles an hour. The chief object of the undertaking is to convey persons quickly across the city, and especially to facilitate access to the city line of railway. The chief objection raised is that the carriages will pass along at the level of the first floor of the houses in the streets which it will traverse, and it is feared this will lead to a depreciation of property.

EXTRAORDINARY.—From the 2nd of March to the 25th of March no patent was filed at the British Patent Office under the head of "Electric Light."

J. VIOLLE, in *Comptes Rendus*, states that the specific heat of iridium, which has been determined up to a temperature of 1,400°, is found to increase regularly with the temperature according to the formula $C_0 = 0{\cdot}037 + 0{\cdot}000006t$. The melting point determined by the calorimetric method is found to be 1950°. The melting points of the different metals determined by the author are—silver, 954°; gold, 1,035°; copper, 1,054°; palladium, 1,500°; platinum, 1,775°; iridium, 1,950°.

TELEPHONIC communication has been established between the meteorological station of the Pic du Midi and Bagnères-de-Bigorre, a distance of 30 kilometres. The Edison telephone is the instrument employed.

THE telephone line erected in the Cape Colony between Kimberley and Du Ports Pan has been purchased by the government.

A NEW diving helmet, with telephone attached, belonging to the Telephone Company, Limited, was tested last Thursday afternoon at Earl Grey Dock, Dundee. The helmet was fitted on Fox, the diver, who descended into the water, and the practicability of the instrument was fully shown by the easy communication which was kept up between the diver and the gentlemen on the quay. A large number of gentlemen were present during the trials, which proved very satisfactory.

DR. OLIVER J. LODGE, in a letter to the *Philosophical Magazine*, thus speaks of Professor Hughes' Induction Balance (described on p. 179, vol. VII, T. J.):—"Soon after hearing of Professor Hughes' discovery, I tried to obtain his effects with numerous coils which happened to be accessible in University College Laboratory, varying the conditions in several ways; and I experienced the most uniform failure in getting a good 'balance' (that is, perfect silence in the telephone) until I abandoned all of them and imitated Professor Hughes' arrangement and dimensions very closely. A 'balance' in fact is a very difficult thing to obtain with such a detector in the circuit as a telephone, for it is influenced not only by the least want of equality, but also by the least want of synchronism between the two opposing electromotive forces. Few persons therefore can appreciate more highly than I do the unremitting toil which Professor Hughes must have devoted to his experiments, before contriving the induction balance and sonometer in their present form."

BY the employment of a hard rubber membrane and a microphone attached to it, and by regulating the pressure of the latter against its contacts, by means of a permanent magnet acting on a piece of iron attached to the movable carbon, Mr. Paul Bert obtains a microphonic transmitter which is free from the disagreeable crackling noises so often perceived in microphonic transmitters of ordinary construction, and which transmits speech with great clearness.

A TELEGRAPH war of large proportions has been commenced in the United States, the new American Union Telegraph Company and its supporters being the assailants, and the Western Union the attacked party. The first move was the seizure, without notice, by the Baltimore and Ohio of all the wires over its lines, which had been worked by the Atlantic and Pacific Company, and in close conjunction with the Western Union. This was followed by the seizure of the wires over the Union and Kansas Pacific lines, the company taking possession and notifying the Western Union to remove certain wires owned by it. All the

seized wires were turned over to the American Union, or at least placed at its disposal. The Western Union was taken by surprise at first, but acted as promptly as possible. A temporary injunction was obtained in time to save its wires on the Missouri Pacific and Central Branch Roads. The fight has since extended to the communications in Eastern cities, and one of the latest incidents reported is a citation served on President Garrett, of the Baltimore and Ohio Company, for contempt of court. It is needless to say that Jay Gould is the originator of the hostilities.—*Railway News.*

AN AMERICAN ELECTRICAL PATENT.—A somewhat curious Patent suit has lately come before the United Sates Circuit Court. The history of this case is briefly as follows:—Many years ago, dating back to 1836, it is said, Charles Grafton Page, of Washington, D.C., first made electrical inventions, among which, it is alleged, was an electrical coil and armature, which had a set screw applied to adjust or regulate the throw or motion of the armature. Without this little set screw, or its mechanical equivalent, it would be practically impossible to work an ordinary telegraph instrument, signal apparatus, burglar alarm, or electric motor. Page suffered his invention to go into public use without taking steps to apply for a patent, and under the general patent laws, in consequence of his neglect, lost all right to a patent. But in 1854 it appears to have occurred to him that perhaps at some future time or another he might coax Congress to grant a special act in his favour, and as preliminary thereto he filed an application for a patent, which under the law was refused examination, on the ground that the invention was public property, and he himself was an examiner in the Patent Office. Page was, in fact, the examiner of electrical patents, and for many years it had been his official duty to issue hundreds of patents, all of which contained his alleged original invention. In 1868 Page was taken sick, and when it appeared that he had not long to live, Congress, at the instance of his friends, with a view to assist his family, passed the following unwise and sweeping act:—

"Chap. XXXII.—An act to authorise Charles Grafton Page to apply for and receive a patent:—Be it enacted by the Senate and House of Representatives of America, in Congress assembled, that the Commissioner of Patents is hereby authorised to receive and entertain a renewal of the application of Charles Grafton Page for letters patent for his 'induction apparatus and circuit-breakers,' now on file in the United States Patent Office, including therewith his circuit-breakers described by him prior to said application; and that if the Commissioner shall adjudge the said Page to have been the first inventor thereof, he *shall issue* to him a patent, *which patent shall be valid* notwithstanding said Page's invention may have been described or in use prior to said application, and notwithstanding the fact that said Page is now an examiner in the United States Patent Office; *provided* that any person in possession of said apparatus prior to the date of said patent shall possess the right to use, and vend to others to use, the said specific apparatus in his possession, without liability to the inventor, patentee, or any other person interested in said invention or patent therefor.—Approved March 19th, 1868."

On the passage of this act the Commissioner of Patents, in accordance with the mandates of the special law, caused the examination to be made, and then ordered the issue of a patent, which was dated April 14th, 1868. Dr. Page died May 5th, 1868.

It was pretty generally doubted at the time of the passage of the law and the grant of the patent, whether the latter could ever be sustained in the courts, and among the greatest doubters were members of the Western Union Telegraph Company. However, as as there would be a possibility of litigation against them in any event by the holders of the Page patent, they concluded that the safest way was to purchase an interest in the patent enough for their own protection, and for a small sum they acquired such interest from the heirs of Mr. Page. Subsequently, it appears, the Western Union Company acquired the substantial control of the patent, and in 1874, after careful preparation, brought this suit against the Holmes Burglar Alarm Company as a test suit.

Judge Blatchford's decision, we understand, sustains all the points made by the plaintiffs. It was urged in the case that the Special Act of Congress, in 1868, was unconstitutional, as the apparatus had been in use so long, but the decision is that the Special Act was constitutional. The validity of the entire patent was affirmed, the claims specifically sustained in the decision being the eleventh, twelfth, and thirteenth, and here is where the great importance of the case appears. These three claims are:—

11. The adjustment of the retractile force of an automatic circuit breaker, as set forth.

12. The combination of an electro-magnet armature and adjustable retractor.

13. Adjusting or regulating the length of vibration of the armature of an electro-magnet by means of a set screw or any mechanical equivalent for substantially the same purpose, substantially as herein set forth.

We intend in a future number to discuss the subject further and present abstracts from the judge's decision, which, we are informed, covers fifty pages, and is a very formidable and exhaustive document.—*Scientific American.*

PONCI'S GALVANIC BATTERY.—A new galvanic battery with circulating liquid, described by Signor Ponci in *Natura* (3, p. 402, 1879), has the following form:—Rectangular lead channels, beak-shaped at one end, are so placed over one another in slanting position that the beak of the first is over the broad end of the second, and so on. In each channel is an amalgamated zinc plate, and above this a carbon plate insulated from it by two rings of caoutchouc; the carbon plate is perforated under the beak of the lead channel above. The lead channels have wires, and the carbon plates, at their upper ends, binding screws, with which they are alternately connected. By means of a caoutchouc syphon a solution of chromate of potash is conducted through the system—200 gr. $K_2Cr_2O_7$, 21 water, 11 commercial muriatic acid; for long use, 3 to 6 litres water and 100 to 150 ccm. muriatic acid may be added to each litre of the solution. A battery of 99 such elements gives a light equal to that of a battery of 60 Bunsens, and is constant in duration.—*Nature.*

Reviews.

A Guide for the Electric testing of Telegraph Cables. By CAPTAIN V. HOSKIER. Second Edition. 1879. E. & F. N. Spon.

THE fact that a second edition has been called for speaks well for the utility of this unpretending little work. Some twenty additional pages have been added on in the new edition, making a handy little volume of seventy-two pages, containing much useful information. For those who wish for a book of reference which tells what tests are necessary for

a cable, both during and after its manufacture, the book in question is exactly the article required, although it does not, except in one or two cases, enter into any explanation of the theory upon which the tests are based, or to explain how the various formulæ used are obtained. Information of the latter kind must be sought for elsewhere, as for instance in Mr. Kempe's "Handbook of Electrical Testing," but the absence of such information in Captain Hoskier's work cannot be regarded as a defect.

Kriegs-Telegraphie. Geschichtliche Entwickelung, Wirkungskreis und Organisation Derselben. By R. VON FISCHER-TREUENFELD. 1879. Stuttgart von W. Kitzinger.

As far as we are aware this book is the first attempt to give a detailed description of military telegraphy. This branch of telegraphic science is by no means new, in fact, as is well known, it was for war purposes that telegraphy was used from the earliest ages. The use of the electric telegraph for field operations is by no means of quite recent date. During the Crimean war a field electric telegraph train, well equipped, was used with considerable advantage by the British army; since that period, although much has been done in the subject, but little has been written on it, possibly because it was policy to keep the matter dark, or at least not to volunteer descriptions of the matériel employed, and of the organisations of the services. Mr. Treuenfeld's work has now enabled this ignorance to be put an end to, to a great extent, and those who wish for information on the subject cannot do better than study his book, where, in a volume of nearly four hundred pages, a very full description is given of the organisations of the military telegraph systems in every part of the world. The book is divided into three parts, the first describing the use that has been made of the telegraph in various campaigns in different parts of the world; the second portion relates to the apparatus and equipments used, and the arrangement of the signalling stations, &c.; and the third part deals with the organisations of the service in the various armies. In many respects the matériel employed for war purposes differs from that used for public purposes, chiefly in the matter of portability, ease of transit being a most important consideration.

Whilst recommending Mr. Treuenfeld's work to those who desire information on the subject, we think its value would be greatly enhanced if an English translation were prepared, as it is not every one who is interested in military telegraphy that has such a command of the German language as will enable him to read and profit by the Kriegs-Telegraphie.

Proceedings of Societies.

PHYSICAL SOCIETY.—MARCH 14th.

DR. HUGGINS in the chair.

New members—Prof. MINCHIN, Mr. HULME, Mr. A. STROH, Prof. D. E. HUGHES, Lieut. WINGFIELD, Mr. MACFARLANE GRAY.

Mr. CHANDLER ROBERTS, F.R.S., drew attention to an explanation which had recently been suggested by Dr. Van Riemsdijk, of Utrecht, to account for the "flashing" which attends the solidification of melted buttons of gold and silver. He showed experimentally that at the point of solidification the metals emit a flash of greenish light, which Dr. Riemsdijk thinks is probably due to the globules being really in what is known as the superfused or surfused state—that is, they fall some degrees below their point of solidification without setting, and the change from the liquid state is accompanied by the liberation of the latent heat effusion which again heats the globule and renders it incandescent. In an attempt to obtain indications as to the state of certain fused metals by the aid of the induction balance, Mr. Roberts was able to show that the resistance of silver in the molten state is far greater than when the metal is solid; and on the other hand, he had confirmed De Lakine's statement, that the resistance of molten bismuth is less than that of the solid metal, and he also obtained evidence that bismuth in cooling may be made to pass through a surfused state similar to that which occurs in the buttons of gold.

Mr. N. LOCKYER thought the greenish tint of the light might be due to a solid film on the globule.

The SECRETARY then read a paper by Prof. W. F. Barrett, announcing that he had found a current of electricity to be generated by the rotation of the prepared chalk cylinder in the receiver of the Edison telephone. When the platinum stylus, which rubs on the cylinder, is connected through a galvanometer to the brass axle on which the cylinder is mounted, a current is observed whose E.M.F. is over $\frac{1}{3}$ volt. This current falls off as the rotation continues, owing, Prof. Barrett surmises, to the electrification of the surface of the chalk. Prof. Barrett attributes the current to friction solely, and seeks to account for the receiving action of Edison's telephone by this frictional current being modified by the transmitted currents, and not by the electrolytic action to which it is usually ascribed. These experiments originated with a suggestion of Prof. Sylvanus Thompson, that the Edison receiver might act as a transmitter. Prof. Barrett had at length succeeded in making it act in this capacity by means of the frictional current.

Mr. SHELFORD BIDWELL exhibited some experiments bearing on Prof. Barrett's observations, which tended to show that the source of the current in the Edison receiver was due to the fact that a voltaic element is formed by the platinum-rubbing point on the brass axle and the prepared chalk. This chalk is usually impregnated with phosphate of soda, or, as in the author's experiments, with caustic, caustic potash, and acetate of mercury. The cylinder seems to be dry, but is probably moist. Melting it greatly increases the current. There is a very feeble current when no motion of the cylinder takes place, but rotation of the cylinder greatly increases it. Platinum is electro-negative to brass, and hence the positive current flows from the platinum to the brass through the galvanometer. This was demonstrated by substituting zinc for platinum, when the current was reversed, and flowed from the brass to the zinc, owing to the fact that brass is electro-negative to zinc. Mr. Bidwell showed, by means of a simple pile of copper and tin-foil, separated by a moist cloth or paper, that the motion of the tin across the paper increased the current of the cell. In the case of a cell made of *two* tin plates separated by moist paper, a current was set up by moving one plate over the other. The plate which moved relatively to the paper was always electro-

negative to the other. Mr. Bidwell also showed by a simple experiment that the action of Edison's receiver was electrolytic. He caused the mere passage of a current to lessen the friction of a metal strap on a drum covered with moist paper, and thereby release the drum by the evolution of hydrogen.

Professor AYRTON pointed out that the rubbing action in these experiments assisted the current by bringing up fresh electrolytic matter, a fact which had been taken advantage of in the construction of several batteries.

Professor ADAMS remarked that this explanation did not seem to explain how the current was *reversed* in the cell composed of *two* tin-foil plates.

Professor GUTHRIE then demonstrated by experiment a curious anomaly in frictional electricity. When flannel is rubbed with ebonite the flannel is + electrified: when ebonite is rubbed with glass the ebonite is + electrified, and we should therefore expect that when flannel is rubbed with glass the flannel would be still more + electrified; but instead of that it is really feebly negative. Perhaps this fact that the heat of friction entering into one substance more than the other affected such results.

The SECRETARY then read a note from Mr. Ridaut stating that he had succeeded in Dr. Guthrie's funnel experiment mentioned at last meeting, and, by means of a stream of water flowing out of a glass funnel, had attracted a glass cone towards the mouth of the funnel. The angle of the cone was greater than the angle of the funnel.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AT an ordinary general meeting of this Society, held March 24th, Mr. W. H. PREECE, President, in the chair, the minutes of the last ordinary general meeting having been read and confirmed, and the list of new and proposed members having been read, the discussion on Mr. ALEXANDER SIEMENS' paper on "Recent Improvements in Electric Lighting," adjourned from the last meeting, was continued.

At the commencement of the discussion a communication from M. BERLY was read by the Secretary.

In 1877 six Jablochkoff candles were in use at the Magasin du Louvre; this number was since increased to 120, produced by means of a 100 horse-power engine. These had been worked for 2¼ years without intermission and with perfect success.

In February, 1878, the Theatre Français and other buildings were illuminated by the Jablochkoff system. The Place du Grand Opéra was also lighted.

In 1878 the Metropolitan Board of Works commenced a trial of the system on the Thames Embankment, 20 lights being used; subsequently other lights were added, on Waterloo Bridge and also the Embankment to Blackfriars Bridge. The number of lights now in use was 60. Messrs. Shoolbred's establishment, in the Tottenham Court Road, was also lighted by the Jablochkoff system, 25 lights being now in use; several other establishments, Messrs. Nicolls, in Regent Street, and Messrs. Samuel Brothers, Ludgate Hill, amongst these. The Picture Gallery, or Salon, in Paris, has also been lighted by the system, 16 dynamo-batteries of 16 lamps each being employed for the purpose. The total number of candles at present in use is as follows:—465 in Paris, 428 in the provinces, and 823 in foreign countries, or 1,716 in all. In this country there are 198. The cost for a large number of candles was 3d. per hour per candle, but this has now been reduced to 2½d. per hour. The cost of the candles, which was originally 8d. each, is now reduced to 4d., the candles burning two hours each, this would be shortly increased to three hours. As regards cost per horse-power, this had been reduced from 5d. per horse-power per lamp to 2d. per horse-power per lamp. An improvement in the candles was effected by covering them with a coating of electro-type copper. A form of candle which relit itself if extinguished had been tried in the British Museum in 1879.

A system of automatic switching from one candle to another, so as to introduce a fresh one on the first being consumed, was now under consideration and trial.

As regards dynamo-machines, M. Berly referred to the Gramme Alternating Current Machine* as being an excellent apparatus.

Gas engines were largely in use for driving the dynamo-machines, and worked very successfully.

In speaking of the progress of the light, M. Berly referred to the ridiculous estimates which had been made from time to time as to the impossibility of burning a large number of lights except at an enormous expenditure of power and labour. The engine power (nominal) of the Thames Embankment lights was equal to 20, and this lighted four and a-half miles of frontage. M. Berly predicted a great future for the electric light.

Mr. MACKENZIE then explained a lamp invented by himself.

Mr. HEINRICHS gave further explanations of his lamp, and stated that it would burn for 30 hours; the unsteadiness which existed was explained to be due to defective carbons, it being difficult at present to make them sufficiently hard in the ring shape.

Mr. HEDGES next explained his lamp. This consisted of two carbons, the ends of which pressed at an angle against a block of lime which was kept continually rotating. The arc formed between the ends of the carbons, and the heat produced, rendered the lime incandescent, thus increasing the light.

Mr. H. F. JOEL then exhibited an improved form of Werdermann lamp. In this arrangement the pencil of carbon pressed against a heavy disc of copper, the latter being hinged; the weight of the disc normally relaxed the grip of a clip which held the carbon-rod, the latter being pressed upwards by means of weights. As the rod consumed, the copper disc tended to fall down, thus relaxing the clip and allowing the rod to rise. The whole arrangement of the lamp was such that the carbon-rod could be replaced with great ease when consumed. The current was turned off and on by means of a switch similar to an ordinary gas tap. When turned off the current was shunted through a resistance formed of carbon-rods. The resistance of the lamp when burning was ·16 ohms, and the average resistance when not burning was ·39 ohms. The faces of the copper clip were now formed of carbon, as it was found that a better contact was obtained by this arrangement. As regards economy, Mr. JOEL stated that by recent improvements the economy had been nearly doubled, and the principle compared favourably with the arc lights.

In reply to Professor ARYTON, Mr. JOEL stated that the resistance of the lamp was ascertained by the substitution method, that is to say, a resistance was inserted in the place of a lighted lamp, and varied until the original strength of current was obtained.

Mr. S. A. PHILLIPS then explained Mr. Brockie's new lamp, a full description of which is given on page 114 of the present number.

Mr. CONRAD COOKE summarised the progress which

* *Telegraphic Journal*, January 15th, 1880.

had been made in electric lighting, pointing out the various steps which had been made.

Mr. LADD said that the BRUSH light at the Liverpool Street Station, which had been installed under his directions, was most remarkable for its steadiness, no flickering being noticeable. He stated that the length of the arc averaged two millimetres, and if a particular lamp was observed by having the carbon points projected on a screen the steadiness of the length of the arc could be well seen; if extra lamps were added in a circuit the arc *immediately* became shortened, and if lamps were taken out the arc was immediately lengthened. The Brush dynamo-machine was remarkable for the absence of heating which took place in its coils. Eight Brush lights had been put up in the South Kensington Museum, and they were remarkable for their steadiness.

Mr. Ladd pointed out that the photometric intensity of the light was dependent upon the level at which it was measured; on a level the light was about 970 candles, but at an angle of 45° below the arc the light was quite 2,000 candles. The engine at Liverpool Street was of 14 horse-power, manufactured by Messrs. Wallace and Stevens, and ran with remarkable steadiness.

Mr. Ladd stated that it was a mistake to burn both gas and electric light, as the one spoiled the effect of the other.

Mr. CROMPTON stated that his lamps, two of which were exhibited in action before the meeting, as a rule, burnt without the slightest flicker; but, like every other lamp, it was necessary that the conditions under which it was tried should be properly arranged, which was impossible in a lecture hall, as proper adjustments could not be made in a short time. Mr. Crompton apologised for having stated that the unsteadiness of Messrs. Siemens' lamp at the previous meeting was due as much to the lamp as to the engine working irregularly. He said that a short arc produced the best effect, and that it was very necessary that the dynamo-machine should be wound to suit the work required of it.

Mr. SHOOLBRED pointed out that great improvements had been made in Messrs. Siemens' dynamo-machines. With reference to M. André's lamp he said that the water joint was a great advantage. Jamin's candle was explained, but Mr. Shoolbred stated that its advantages had not been fairly proved as yet.

As regards the general question of illumination, that is to say, of a number of gas lamps as compared with a small number of electric lamps, Mr. Shoolbred said that the question of *space* illuminated was a factor which had not been sufficiently taken into consideration.

In reply, Mr. ALEXANDER SIEMENS said that it was difficult to please every one, and that his reason for not describing every system was that he preferred to describe the one he knew most about. He very strongly protested against the practice of stating the *nominal* horse-power of an engine and not the indicated horse-power; the latter was the only true index of the work done, and the only factor upon which an estimate of cost could be based. In reply to Mr. Ladd, Mr. Siemens stated that the photometric measurements of their lamps were always made on a level with the latter; the space lighted, he agreed, was a factor to be considered, and this to a considerable extent limited the use of the electric light to very large spaces from an economical point of view. In the Albert Hall the electric light was economical for this reason. For street-lighting he did not consider electric lighting to be cheap.

In proposing a vote of thanks to Mr. Siemens, the PRESIDENT argued that it was unfair to compare electric with gas lighting, as the two had their distinct fields of usefulness. He thought there was still great room for improvement in electric lighting, but the engines for the purpose had been brought to a great state of perfection, notably the Wallace-Stevens engine. As regards the dynamo-machine opinions differed as to the relative efficiency of the various patterns, an opinion generally being in favour of the machine which any particular individual had tried. Mr. Preece also insisted upon the question of space lighted being always taken into consideration in making estimates.

The meeting then adjourned.

The next meeting will take place April 14, at which Dr. C. W. Siemens will lecture on "Applications of Dynamo-Electric Machine."

New Patents—1880.

1046. "A new or improved method for compressing air by electricity for obtaining motive power." V. POULT and E. COMMELIN. Dated March 10.

1079. "Improvement in self-acting regulators for the expansion and contraction of metallic wires used for working railway signals." G. EDWARDS. Dated March 12.

1081. "Telephonic Apparatus." E. H. W. HIGGINS. Dated March 12.

1125. "Improvements in electric railway signals and in electric safety appliances for railways and railway trains." J. C. MEWBURN. (Communicated by T. A. B. Putnam.) Dated March 16.

1136. "Magneto-electric and dynamo-electric machines." J. H. JOHNSON. (Communicated by A. de Meritens.) Dated March 16.

1151. "An improved micro-telephonic apparatus for intensifying sound during transmission." R. H. COURTENAY. Dated March 17.

1178. "A dynamo or magneto-electric machine to convert mechanical energy into electricity, or to convert electricity into mechanical energy." J. PERRY. Dated March 18.

1184. "Improvements in, and in apparatus for, insulating, containing, and protecting surface and underground telegraph wires." J. T. KING. (Communicated by C. Lindford.) Dated March 19.

1212. "Improvements in electrical fire alarms, and for giving immediate notice of the outbreak of fire from any outlying or other station to the district or chief engine station, or between each station." C. E. SPAGNOLETTI. Dated March 20.

1234. "Improvements in galvanic batteries, and in the composition, preparation, and regeneration of the materials employed therein." A. M. CLARK. (Communicated by N. E. Reynier.) Dated March 22.

1244. "Improvements in regulating electro-magnetic motors and in the apparatus employed therein." J. H. JOHNSON. (Communicated by W. W. Griscom.) Dated March 23.

1259. "Electro-magnetic motors and dynamo-electric machines. J. H. JOHNSON. (Communicated by W. W. Griscom.) Dated March 24.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

2575. "Telegraphic apparatus for railways." EDWARD TYER. Dated June 26. 6d. Relates to apparatus employed on railways for the purpose of communicating from one part of a line to another signals as to the arrival, departure, or condition of

trains, so as to guide the attendants in the working of the points and signals under their charge. Hitherto signalling instruments have been employed showing by the position of an index on a dial the character or destination of an approaching train. The object of the invention is to provide for such instruments means of securing such slowness and regularity in the transmission of the operating currents that the index shall not trip, but shall always be moved over the proper number of divisions of the dial to give the signal intended.

2821. "Automatically opening and closing electrical circuits." G. ZANNI. Dated July 10. 6d. Consists of an electro-magnetic apparatus constructed and arranged in combination with the magneto-electric machine, or a battery or other generation of electricity (either connected or not connected with the said dynamo-electric machine) in such a manner that the said circuit will be closed or opened automatically whenever the dynamo-electric machine commences or ceases to work in plating processes.

2878. "Manufacture of magnetic stays, corsets," &c. W. WILSON. Dated July 15. 6d. Consists in perforating the magnets used with three or other number of holes, the object of which is to set up a local electric action when the said magnets are fastened to the fabric by eyelets of suitable mixed metals, such as brass or other alloy, &c.

2962. "Joints of pipes for containing underground telegraph wires." A. M. CLARK. (A communication from L. A. Herrmann, of Paris.) Claims a spigot and socket joint for pipes with a groove to contain the lead packing. The combination of this socket with a lead packing, formed either by running in the molten metal as usual, or by "setting up" or compacting a ring of lead divided diametrically, or by winding a lead wire several times round the spigot end and setting it up or compacting it when in place.

3085. "Regulators for the electric light." B. J. B. MILLS. (A communication from Francisque Million, of Cours Morand, Lyons.) Dated July 30. 6d. The carbons are carried by supports which slide vertically, and are formed with rack teeth to gear with a toothed pinion, which, according as it turns to the right or the left, causes the points of the carbon to approach or separate from each other. Upon the axis of this pinion is fixed a larger wheel, toothed around its circumference, and upon which acts a regulating instrument carried by a balance or pendulum, which is furnished with an iron armature operated by the electro-magnet traversed by the current. Two stops limit the motion of this balance or pendulum, which is drawn back by a spring in opposition to the electro-magnet. The regulating instrument is formed simply of a tooth fixed to the extremity of a spring carried by a cross-piece fixed to the balance or pendulum, and the tension of which is regulated by a screw.

3132. "Electrical communication between ships and shore." SEVERIN LAURITZEN, W. C. JOHNSON, and S. E. PHILLIPS. Dated August 2. 2d. To enable a ship and the shore to communicate with each other, a telegraphic cable is laid out to sea for the required distance, and the passing vessel is provided with a short length of cable, which is trailed along the bottom of the sea. Currents of electricity are sent into the trailing cable, and when this approaches or passes over the other cable, these currents will be appreciable on shore by means of a telephone, galvanometer, or any other suitable method of appreciating electric currents, but preferably by the former. (*Provisionally only.*)

3272. "Electric lightning apparatus." W. R. LAKE. (A communication from Dr. Luiji Concornotti, of Crémone.) Consists of two metallic rods and a rod of carbon. The contact between this carbon bar and the two rollers is at first only along two very narrow zones corresponding to the geometrical generating lines. During the passage of the current this contact is, so to speak, no longer absolute by reason of the repulsions of the contiguous elements of one single current. The result is that two very small voltaic arcs are formed, whilst the portion of the carbon interposed between these arcs become incandescent.

4170. "Interlocking the telegraphic block instruments with the points and signals of railways." CHAS. HODSON. Dated October 15. 6d. Relates to the interlocking of the telegraphic block instruments employed on railways with the points and signals thereof in such a manner as to give greater security to the traffic. It consists of three principal organs, namely, first, of a locking handle; second, of a commutator with its plunger; third, a detent.

4976. "Apparatus for affecting telephonic communication." JOHN IMRAY. Dated Dec. 5. 6d. Consists of a system of interrupters for telephonic exchange use; and also relates to the construction of the said interrupter and an indicator for use with same.

5004. "Telephones." JOHN IMRAY. Dated Dec. 5. 4d. Relates to the construction of a telephone in which a permanent magnet of horse-form has one of its limbs extending across the gap between the limbs, and carrying an electro-magnet and a diaphragm with its casing.

City Notes.

Old Broad Street, March 30th, 1880.

DIRECT SPANISH TELEGRAPH COMPANY, LIMITED.—The report of the directors for the half-year ending 31st December, 1879, to be presented at the general meeting of shareholders to be held on Wednesday, the 31st March, 1880, states that the accounts for the half-year ending 31st December, 1879, show a balance to the credit of profit and loss of £4,450 2s. 5d. The traffic receipts for the half-year are £1,847 13s. 3d. in excess of those for the preceding half-year, and £1,664 5s. 11d. in excess of those for the corresponding period of 1878. The directors deeply regret that, notwithstanding the very favourable result accruing from the increased traffic during the last six months, they are not in a position to recommend the payment of any dividend, either on the preference or ordinary shares. The shareholders may probably remember that a fault of insulation occurred in the Bilbao Cable last October. Although it did not stop the traffic, the fault, caused by the small insect known as the "teredo navalis" perforating the gutta-percha, would soon have caused a complete interruption, and it was therefore deemed advisable to have it removed at once, more especially as an opportunity presented itself of doing so under favourable circumstances as regards expense by the employment of the s.s. *Dacia*, then on her way home from Algeria. The cost of rectifying this fault, after deduction of value of recovered cable, the shareholders will find in the accounts. On the evening of the 31st December last the Bilbao Cable broke down, and, after a series of most difficult operations, its complete restoration was only effected on the 15th instant. The directors cannot ascertain the amount they will have to provide to meet the expenses of these operations until the return of the expedition, but it has been necessary to use such a quantity of new cable, and the time the ship has been occupied has been so long, in consequence of very tempestuous weather, that the

Board are under the necessity of retaining the whole of the reserve fund and the balance at the credit of profit and loss to meet their liabilities for these repairs. Since the completion of the repairs this cable is in excellent condition, and the Barcelona-Marseilles Cable continues in the same perfect electrical state as heretofore.

THE accounts of the Eastern Extension Australasia and China Telegraph Company (Limited) to the 31st December last, show (subject to audit) a balance of £106,825, after payment of three interim quarterly dividends. Out of this sum the Board propose to pay on the 22nd of April, a final dividend of 2s. 6d. per share, or at the rate of 5 per cent. per annum for the year 1879, and to carry the balance of £81,856 to the reserve fund.

THE Eastern Telegraph Company notify the payment of an interim dividend of 2s. 6d. per share, payable on and after April 14th.

THE directors of the Brazilian Submarine Telegraph Company (Limited) have declared an interim dividend of 2s. 6d. per share, or 5 per cent. per annum, free of income tax, for the quarter ended December 31st last.

THE directors of the Indo-European Telegraph Company (Limited) have determined to recommend to the shareholders the payment of a dividend for the six months ending December 31st, 1879, of 17s. 6d. per share, making, with the interim dividend already paid, 6 per cent. for the year 1879, free of income tax.

AT a meeting of the Board of Directors of the Anglo-American Telegraph Company (Limited), it was resolved (after placing £37,500 to the renewal fund) to declare an interim dividend for the quarter ending the 31st instant of 1 per cent. on the ordinary stock, and of 2 per cent. on the preferred stock, both free of income tax, payable on May 1st to the shareholders registered on the books of the Company on April 1st.

THE Great Northern Telegraph Company proposes, at the general meeting, to be held at Copenhagen on April 24, to recommend a final dividend for the year 1879 of 2s. 9d. per £10 share, making the total division for that year equal to 6¾ per cent., to put £44,444 8s. 10d. to the reserve fund, and to carry forward £16,242 7s. 4d.

THE directors of the Western and Brazilian Telegraph Company (Limited) have arranged with the Telegraph Construction and Maintenance Company for 400 miles of cable to be laid as soon as possible.

THE WESTERN AND BRAZILIAN TELEGRAPH COMPANY (Limited) under date of March 5th, announce the repair of their Para Maranham section.

THE DIRECT SPANISH TELEGRAPH COMPANY (Limited) have announced the restoration of direct cable communication with Spain, *via* Bilbao.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 59¾-60¼; Ditto, Preferred, 89-90; Ditto, Deferred, 32½-33; Brazilian Submarine, Limited, 7⅞-8; Cuba, Limited, 9¼-9½; Cuba, Limited, 10 per cent. Preference, 16-16½; Direct Spanish, Limited, 2-2½; Direct Spanish, 10 per cent. Preference, 10½-11; Direct United States Cable, Limited, 1877, 11-11¼; Scrip of Debentures, 100-102; Ditto, £25 paid, 1-3 pm.; Eastern, Limited, 8¼-9¼; Eastern 6 per cent. Preference, 12-12½; Eastern, 6 per cent. Debentures, repayable October, 1883, 103-106; Eastern 5 per cent. Debentures, repayable August, 1878, 100-102; Eastern, 5 per cent., repayable Aug., 1899, 101-103; Eastern Extension, Australasian and China, Limited, 8¼-9; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 105-108; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 100-102; Ditto, registered, repayable 1900, 101-103; German Union Telegraph and Trust, 8¼-9; Globe Telegraph and Trust, Limited, 5⅛-5¼; Globe, 6 per cent. Preference, 11¼-11½; Great Northern, 9¼-9½; Indo-European, Limited, 24-26; Mediterranean Extension, Limited, 3-3⅛; Mediterranean Extension, 8 per cent. Preference, 10¼-11¼; Reuter's Limited, 10-11; Submarine, 230-240; Submarine Scrip, 2-2½; West Coast of America, Limited, 1⅛-1⅛; West India and Panama, Limited, 1⅛-1⅛; Ditto, 6 per cent. First Preference, 7⅛-8; Ditto, ditto, Second Preference, 7-7⅛; Western and Brazilian, Limited, 7-7⅛; Ditto, 6 per cent. Debentures "A," 100-103, Ditto, ditto, ditto, "B," 100-103; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 102-104; Telegraph Construction and Maintenance, Limited, 32¾-33¼; Ditto, 6 per cent. Bonds, 103-107; Ditto, Second Bonus Trust Certificates, 2½-3½; India Rubber Co., 13½-14; Ditto, 6 per cent. Debenture, 106-108.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,212,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,000	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£	£	£ [a]	£	£
February, 1880	*	13,517	3,200	*	*	44,591	25,190	14,160	... ...	*	1,300	11,490	5,410
February, 1879 ...	42,540	12,558	2,800	784	14,180	37,257	22,409	12,087	... ...	8,658	2,400	*	4,965
Increase	... ...	959	400	... ...	... ...	7,334	2,781	2,073	... ...	... ...	... ...	... ...	... ...
Decrease	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	1,100	... ...	445

* Publication of receipts temporarily suspended. [a] January receipts £1,225.